Academic Program: PG

Academic Year 2026-27

Department of Computer Science & Engineering

Computer Science & Engineering

I & II Semester M.Tech.

Syllabus

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002

(An Autonomous Institution recognized by AICTE & Affiliated to VTU, Belagavi)

Ph: 0836-2447465 **Fax: 0836-2464638** **Web:** www.sdmcet.ac.in

S D M College of Engineering & Technology, Dharwad
Department of Computer Science & Engineering

College Vision and Mission

Vision:

To develop competent professionals with human values.

Mission:

1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

Department Vision and Mission

Vision:

To develop competent professionals in the field of Computer Science and Engineering with human values.

Mission:

1. To have contextually relevant curricula in line with industry trends and body of knowledge stated by IEEE /ACM.
2. To promote OBE effective Teaching Learning Practices supported by modern educational tools and techniques.
3. To enhance research.
4. To involve the industrial expertise for connecting classroom contents to real-life situations.
5. To inculcate ethics and soft-skills leading to overall personality development.

S D M College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for I & II semester M.Tech. in Computer Science & Engineering is recommended by the Board of Studies of Computer Science & Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2026-27 till further revision.

Chairman BoS & HoD **Principal**

Program Educational Objectives (PEOs):

i. Contribute to the profession as an excellent employee or as an entrepreneur

ii. Enhance their knowledge informally or by pursuing research work leading to new innovations and products

iii. Work effectively in heterogeneous environment and be responsible member and leader of their communities

iv. Contribute positively to the needs of individuals and society at large by understanding the human, social and environmental context of their profession

Program Outcomes (POs):

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: Student should be able to demonstrate a degree of mastery over the current knowledge and technological trends in the field of Computer Science & Engineering.

PO4: Demonstrate the knowledge and understanding of Computer Science & Engineering and manage a project in a multidisciplinary environment.

PO5: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices

PO6: Recognize the need for and have the preparation and ability to engage independent and life-long learning in the context of technological change.

Sustainable Development Goals

SDG1: No Poverty

SDG2: Zero Hunger

SDG3: Good Health and Well-being

SDG4: Quality Education

SDG5: Gender Equality

SDG6: Clean Water and Sanitation

SDG7: Affordable and Clean Energy

SDG8: Decent Work and Economic Growth

SDG9: Industry, Innovation, and Infrastructure

SDG10: Reduced Inequalities

SDG11: Sustainable Cities and Communities

SDG12: Responsible Consumption and Production

SDG13: Climate Action

SDG14: Life Below Water

SDG15: Life on Land

SDG16: Peace, Justice, and Strong Institutions

SDG17: Partnerships for the Goals

Scheme of Teaching and Examinations – 2026-27
M.Tech, Computer Science and Engineering

I SEMESTER													
Sl. No	Course Type	Course Code	Course Title	Teaching & Learning Scheme					Examination				Credits
				CI		LI	TW & SL	Total Hours/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	T	P							
1	MAT/PCC	26PCSC101	Applied Mathematics	42	0	0	48	90	03	50	100	100	3
2	PCC	26PCSC102	Advanced AIML	42	28	0	50	120	03	50	100	100	4
3	PCC	26PCSC103	Advanced Computer Networks	42	0	0	48	90	03	50	100	100	3
4	IPCC	26PCSI104	Advanced Operating Systems	42	0	28	50	120	03	50	100	100	4
5	PEC	26PCSE15X	Professional Elective Course-I	42	0	0	48	90	03	50	100	100	3
6	PCCL	26PCSL106	Advanced AIML Lab	0	0	24	06	30	03	50	50	100	1
7	NCMC	26PRMK107	Research Methodology and IPR	28	0	0	32	60	02	50	50	100	2
								TOTAL				**700**	**20**

Elective List Ist Sem:

Sl. No	Course Code	Course title
1	26PCSE151	Block Chain Technology
2	26PCSE152	Image and Video Analytics
3	26PCSE153	High Performance Computing

Scheme of Teaching and Examinations – 2026-27
M.Tech, Computer Science and Engineering

II SEMESTER													
Sl. No	Course	Course Code	Course Title	Teaching & Learning Scheme					Examination				Credits
				L	T	P	TW & SL	Total Hours /Semester	Duration in hours	CIE Marks	SEE Marks	Total Marks	
1	PCC/IPCC	26PCSC201	Deep Learning	42	28	0	50	120	03	50	100	100	4
2	PCC	26PCSC202	Edge Computing	42	0	0	48	90	03	50	100	100	3
3	PCC	26PCSC203	Network and Cyber Security	42	0	0	48	90	03	50	100	100	3
4	PEC	26PCSE24X	Professional Elective Courses-II	42	0	0	48	90	03	50	100	100	3
5	PEC	26PCSE25X	Professional Elective Course-III	42	0	0	48	90	03	50	100	100	3
6	PEC	26PCSE26X	Professional Elective Course-IV	42	0	0	48	90	03	50	100	100	3
7	PCCL	26PCSL207	Deep Learning Lab	0	0	24	6	30	03	50	50	100	1
8	PCC	26PCSP208	Minor Project / Pedagogical Skill Development	0	0	0	28	28	03	50	50	100	2
								Total				**800**	**22**

Elective Group -1

Sl No	Course Code	Course title
1	26PCSE241	Agile Technology
2	26PCSE242	Software Project Management Tools
3	26PCSE243	Software Engineering and DevOps

Elective Group -2

Sl No	Course Code	Course title
1	26PCSE251	Data Science & Applications
2	26PCSE252	Analysis of Computer Networks
3	26PCSE253	Big data & AI Applications

Elective Group -3

Sl No	Course Code	Course title
1	26PCSE261	Biomedical Image Processing
2	26PCSE262	Advanced Algorithms
3	26PCSE263	Human Computer Interface

Professional Elective Courses (PECs): Professional Elective Courses – PEC–I and PEC–II – are common to all branches of specialization within a particular Engineering stream. Students may choose the most appropriate elective based on their field of specialization and academic requirements. Note: The number of courses listed under each PEC group may exceed four, depending on the specializations under one stream.

Integrated Professional Core Courses (IPCC): The Group comprises specialization specific core courses that are integrated with a practical component, ensuring application-oriented learning aligned with industry and research needs. The number of courses in the group depends on the number of specializations offered under a particular engineering stream.

Minor Project: The Minor Project is intended to provide postgraduate students with practical exposure to problem identification, literature survey, research methodology, technical analysis, implementation, and report writing. It is to encourage students to apply the concepts learned in their coursework to a specific technical / research problem. The topic should be relevant to the student's PG programme and should address a specific technical, industrial, societal, or research problem. The topic may be experimental, simulation-based, design-oriented, analytical, or application-oriented. Students should conduct a preliminary literature survey before finalizing the topic. The proposed topic should be approved by the DPGC. The Minor Project has to be carried out individually. Evaluation is 50 % through CIE and 50 % through SEE. Minimum of 3 reviews to be conducted. 40 % of CIE is through the review committee and the remaining 60% is through the guide.

Skill Development Project: A Skill Development Project is intended to strengthen technical, problem-solving and related professional skills. It is also to improve demonstration capability and documentation skills. The proposed topic should be approved by the DPGC. It has to be carried out individually. Evaluation is 50% through CIE and 50% through SEE. Minimum of 3 reviews to be conducted. 40% of CIE is through the review committee and the remaining 60% is through the guide.

I Semester

26PCSC101	Applied Mathematics	(42-0-0-48) 3

Hours: 90

Course learning Objectives (CLO's):

- To enable learning concepts of probability theory and their implication in Computer Science and Engineering.
- To develop proficiency in vector spaces and linear transformations.
- To have an insight into solving Linear Algebraic Equations and the importance of Eigen values and Eigen vectors in singular value decompositions.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to Pos (1 to 6)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Apply** the concept of probability distributions in analyzing the probability models arising in random processes.	-	1,2	-
CO-2	**Apply** the concept of vector space to solve problems in engineering	-	1,2	-
CO-3	**Compute** orthogonal and ortho normal basis vectors required to analyze image and signal processing problems.	-	1,2	-
CO-4	**Apply** the technique of singular value decomposition for data compression, least square approximation in solving inconsistent linear systems.	-	1,2	-
CO-5	**Solve** system of linear and non-linear equation arising in engineering fields.	-	1,2	-

PO's	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.0	2.0	-	-	-	-

Prerequisites: Basics of Probability, Matrices and Vectors.

1 Probability Theory

Review of basic probability theory. Definitions of random variables and probability distributions, probability mass and density functions, expectation, moments, central moments, characteristic functions, probability generating and moment generating functions-illustrations. Binomial, Poisson, Exponential, Gaussian and Rayleigh distributions and examples **08Hrs**

2 Vector Space

Introduction to vectors paces and sub-spaces, definitions column, Null spaces, spaces illustrative example. Linearly independent and dependent vectors-Basis definition and problems. Linear transformations definitions. Matrix form of linear Transformations-Illustrative examples. **08Hrs**

3 Orthogonality and least squares

Inner product, orthogonal vector, orthogonal bases, orthogonal projections. Gram-Schmidt orthogonalization process. QR factorizations of a matrices, least square problems. Applications to linear models (least square lines and least square fitting of other curves). **08Hrs**

4 Linear Algebra

Solution of Systems of Linear Equations by Partition method, Eigen values and Eigen vectors of matrices. Given method for symmetric matrices. Diagonalization, The Singular value decomposition. Applications to image processing and statistics, Principal Component Analysis. **09Hrs**

5 Optimization

Simplex Algorithm and Simplex method. Nonlinear Programming Constrained extremal Problems: Lagrange's multiplier method, Kuhn-Tucker conditions and solutions. **09Hrs**

Reference Books:

1 David C. Lay, Steven R. Lay and J. J. McDonald, "Linear Algebra and its Applications", Pearson Education Ltd 5th Edition 2015.

2 Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 4th Edition, 2017

3 T. Veerarajan," Probability, Statistics and Random Process"**,** Tata Mc-Graw Hill Co 3rd Edition 2016.

4 Venkataraman M K,"Higher Engineering Mathematics",National Pub.Co,1992

5 Taha H A, "Operations research- An Introduction", Mc Milan Publishing Co, 1982.

26PCSC102 Artificial Intelligence and Machine Learning (42-28-0-0) 4

Contact Hours: 120

Course Learning Objectives (CLOs)

Objective of this course is to make student knowledge-full enough to determine when an AI approach is appropriate for a given problem, identify the appropriate representation, reasoning mechanism, models, algorithms, implement and evaluate it.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course, the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** knowledge representation techniques and logical reasoning in AI systems	-	3,4	-
CO-2	**Apply** probabilistic and quantitative techniques to model uncertainty and support AI decision-making.	-	3,4	-
CO-3	**Apply** the fundamental concepts of neural networks, including perceptron models, multilayer architectures**.**	-	3,4	-
CO-4	**Analyze** and evaluate neural architectures and machine learning models for real-time AI applications	-	3,4	-
CO-5	**Apply** Deep Learning concepts to design and evaluate Convolutional Neural Networks for AI applications.	-	3,4,5	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**-**	**-**	**2.0**	**2.0**	**2.0**	**-**

Prerequisites: Knowledge of Logic, Discrete Mathematic, Programming fundamentals.

Contents:

1. **Introduction to Artificial Intelligence**: Introduction, solving problems by searching, Search in Complex Environments, Local Search and Optimization Problems, Local Search in Continuous Spaces, Search with Nondeterministic Actions, Search in Partially Observable Environments, Online Search Agents and Unknown Environments, Constraint Satisfaction Problems. **08Hrs**
2. **Quantifying Uncertainty:** Acting under Uncertainty, Basic Probability Notation, and Inference Using Full Joint Distributions, Probabilistic Reasoning and Probabilistic Reasoning Over Time. **08Hrs**
3. **Introduction to Neural Networks:** The Basic Idea of Neural Networks, Single Computational Layer: The Perceptron, Use of Bias, The Base Components of Neural Architectures, Multilayer Neural Networks, The Importance of Nonlinearity, Backpropagation Algorithm, Vector-Centric View of Backpropagation, Tuning and Preprocessing**.** **10Hrs**
4. **Machine Learning with Shallow Neural Networks**: Neural Architectures for Binary Classification Models, Least-Squares Regression, Widrow-Hoff Learning, Support Vector Machines, Logistic Regression, Comparison of Different Models.
   Radial Basis Function Networks: Introduction, Training an RBF Network, Training the Output Layer, Iterative Construction of Hidden Layer, Variations and Special Cases of RBF Networks, Relationship with Kernel Methods. **10Hrs**
5. **Reinforcement Learning** - The Learning Task, Q Learning, Nondeterministic rewards and actions, Temporal difference learning, Generalizing from examples, relationship to Dynamic Programming. **06Hrs**

Reference Books:

1. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd Edition, Prentice Hall, 2009
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw Hill,1991.
3. Neural Networks and Deep Learning - Charu Aggarwal, Springer Nature Switzerland AG 2018, 2023
4. Bishop-“Pattern-Recognition-and-Machine-Learning”Springer,1st Edition,2006.

26PCSC103 Advanced Computer Network (42-0-0-48) 3

Contact Hours: 90

Course Learning Objectives (CLOs):

This course focuses on advanced concepts of Computer Networks, protocols, internetworking and congestion algorithms.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** and **apply** advanced networking concepts and techniques to design and solve computer networking problems.	-	3	-
CO-2	**Explain** and apply various switching and Internetworking mechanisms.	1	3	4
CO-3	**Explain** and apply various intra-network and internetwork routing algorithms.	1	3	4
CO-4	**Demonstrate** a systematic and Critical understanding of end-to-end issues.	1	3	4
CO-5	**Explain** various congestion control techniques and traffic engineering	1	3	4

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**3**	**-**	**2**	**1**	**-**	**-**

Prerequisites: Basic Knowledge of Computer Networks.

Contents:

1. **Foundation**: Building a Network, Requirements, perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, DelayX Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait, Sliding Window, Concurrent Logical Channels. **07 Hrs**
2. **Internetworking I**: Switching and Bridging, Datagram's, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels. **07 Hrs**
3. **Internetworking II**: Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP. **08 Hrs**
4. **End-to-End Protocols**: Simple de-multiplexer (UDP), Reliable Byte Stream (TCP), End to-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery. **10 Hrs**
5. **Congestion Control and Resource Allocation:** Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP, POP, IMAP, MIME), World Wide Web (HTTP), Network Management (SNMP). Traffic Engineering: Requirement, Traffic Sizing, Characteristics, Protocols, Time and Delay Considerations, Connectivity, Availability, Reliability, Maintainability and Throughput, Software-Defined Traffic Engineering. **10 Hrs**

Reference Books:

1 Larry Peterson and Bruce S Davis, “Computer Networks: A System approach”, 5th Edition, Elsevier 2014.
2 Douglas E Comer, “Internetworking with TCP/IP, Principles, Protocols and Architecture”, 6th Edition, PHI 2014.
3 Uyless Black, “Computer Networks, Protocols, Standards and Interfaces”, 2nd Edition - PHI.2000.
4 Behrouz A Forouzan, “TCP /IP Protocol Suite” 4th Edition – Tata McGraw Hill, 2017.
5. G. Wright and W. Stevens, TCP/IP Illustrated, Volume 1 and 2, Addison-Wesley, 1996.
6. R. Srikant, The Mathematics of Internet Congestion Control, Springer, 2004.

26PCSI104 Advanced Operating Systems (42-0-28-50) 4

Contact Hours: 120

Course Learning Objectives (CLOs)

Objective of this course:

- Analyze the characteristics of operating systems for multiprocessor and multicomputer architectures.
- Understand and address the challenges related to designing operating systems.
- Explore the latest trends in developing mobile operating systems.
- Evaluate the implications of these trends on performance and user experience.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course, the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** the characteristics of operating systems for multiprocessors and multicomputer architectures	-	3,4	-
CO-2	**Illustrate** and address the challenges related to designing operating systems and their implications.	-	3,4	-
CO-3	**Explain** the latest trends in developing mobile operating systems and evaluate their impact on performance	-	3,4	-
CO-4	**Design** multi-processes and multithreading schemes for concurrent	-	3,4	-
CO-5	**Apply** process concurrency, file systems, protection, and data integrity mechanisms across different operating systems.	3,4,5	-	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**-**	**-**	**2.0**	**2.0**	**2.0**	**-**

Prerequisites: Knowledge of basic operating system concepts, Programming fundamentals.

Contents:

1. **Multiprocessor Operating Systems**: System Architectures- Structures of OS – OS design issues – Process synchronization – Process Scheduling and Allocation- Memory Management. **8Hrs**
2. **Distributed Operating Systems**: System Architectures- Design issues – Communication models – clock synchronization – mutual exclusion – election algorithms- Distributed Deadlock detection **8Hrs**
3. **Distributed scheduling:** Distributed shared memory - Distributed File system – Multimedia file systems – File placement – Caching. **8Hrs**
4. **Network Operating Systems and Security:** Introduction to Network OS – Network OS vs Distributed OS, Goals of NOS; Layered architecture of NOS, Network Stack; Communication mechanisms; Resource sharing in NOS; Network OS Services; Synchronization & Coordination; Fault Tolerance & Reliability. Case Study – UNIX/Linux, Windows, Google File System (Overview). **10Hrs**
5. **Mobile Operating Systems**: Processor architectures - Power Management - Mobile OS Architectures -Underlying OS - Kernel structure and native level programming - Runtime issues- Approaches to power management **8Hrs**

Reference Books:

1 M Singhal and NG Shivaratri, Advanced Concepts in Operating Systems, Tata McGraw Hill Inc, 2001
2 Andrew S. Tanenbaum, Maarten van Steen, Distributed Systems: Principles and Paradigms, Pearson Prentice Hall, 2007
3 Source Wikipedia, Mobile Operating Systems, General Books LLC, 2010

26CSL106	Advanced AIML Lab	(0-0-24-6) 1

Contact hours: 30

Course Learning Objectives (CLOs):

To provide hands on support to the students' study to determine when an AI approach is appropriate for a given problem, identify the appropriate representation and reasoning mechanism models, algorithms, implement and evaluate it.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course, the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Implement** single-layer and multilayer neural networks	-	3,4	-
CO-2	**Iimplement** and compare machine learning models such as SVM, Logistic Regression, and Least-Squares	-	3,4	-
CO-3	**Implement** Q-Learning for reinforcement learning problems	-	3,4	-
CO-4	**Analyze** and **apply** Temporal Difference Learning for sequential decision-making problems	-	3,4	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	-	-	2.0	2.0	2.0	-

Associated Lab Assignments (Sample):

1. Apply search techniques using informed and uninformed search.
2. Build a decision tree for the case of SDMCET students' performance based on the IA-1, IA-2, IA-3, CTA, Attendance, SEE marks (optional) and classifying them into one of the Grade S, A, B, C, D, E & F. Study of precision of classification by including the 10^{th}, 12^{th} and CET/COMED-K into consideration.
3. Given the features of an email like , Sender's email ID, Number of typos in

the email, Occurrence of words like "offer", "prize", "free Gift", classify the email as Spam or not. Use the feature vector to train a Logistic classifier which emits score in the range 0 to 1. If the score is more than 0.5, we label the email as spam. Otherwise, we don't label it as spam. (From https://magoosh.com/).

4. Apply regression techniques to predict the salary of an employee.
5. Apply supervised learning algorithms to classify the known data.
6. Apply unsupervised learning algorithm to classify the unknown data.
7. Build recommendation system.

26PRMK107 Research Methodology and IPR (28-0-0-32) 2

Contact Hours: 60

Course Learning Objectives (CLOs):

The students are expected to understand the need, significance, and types of research; formulate research problems; conduct literature reviews; and gain knowledge of measurement, scaling techniques, data collection methods, hypothesis testing, interpretation of results and research report writing.

Further, students will learn about Intellectual Property Rights (IPR), including copyrights, trademarks and patents; patent filing procedures; patent infringement and remedies; and the provisions of the Information Technology Act.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO1	**Formulate** research problems, conduct literature reviews and identify appropriate research methodologies.	-	1	-
CO2	**Apply** measurement and scaling techniques and carry out systematic data collection.	-	1	-
CO3	**Test** hypotheses, interpret and analyse research results, and prepare research reports**.**	2	3	-
CO4	**Explain** the need and importance of IPR, including copyrights, patents and trademarks; and understand intellectual property infringement, remedies and the relevant regulatory framework.	-	2	-

Mapping Level:

PO's	**1**	**2**	**3**
Mapping Level	**2.0**	**2.5**	**2.0**

Contents:

1. **Research Methodology:** Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, research process, criteria of good research and problems encountered by researchers in India. **Defining the Research Problem:** Research problem, selecting the problem, technique involved in defining a problem, an illustration. **04 Hrs**
2. **Reviewing the literature:** How to review the literature, searching the existing literature, reviewing the selected literature. **Research Design:** Meaning of research design, need for research design, features of a good design, important concepts relating to research design, different research designs. **04 Hrs**
3. **Measurement and Scaling:** Measurement in research, measurement scales, sources of error in measurement. **Data Collection:** Collection of primary data, collection of secondary data. **04 Hrs**
4. **Testing of Hypotheses:** What is a Hypothesis? Basic concepts concerning testing of hypotheses, the procedure for hypothesis testing, the flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses. **04Hrs**
5. **Interpretation and Report Writing:** Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, precautions for writing research reports, plagiarism and its significance. **03 Hrs**
6. **Introduction to Intellectual Property Rights:** Meaning and conception of IPR, competing, rationale for protection, international conventions, world court. **Copy right:** Meaning, content, substance, ownership, primary, special rights, obligations, period, assignment, and relinquishment of copyrights. License and application for registration of copyright. **Patents:** meaning of patent purpose and policy of patent law, gains to inventor, application of patents, joint application, discovery and invention, patentable and non-patentable inventions. **Industrial design:** Concepts & Significance. **Trademarks:** Definitions and conceptions of Trademark, advantages of registration, procedure for registration, procedure, and certification of Trademarks. **Infringement and Remedies:** Meaning of infringement, acts of infringement **07 Hrs**

Reference Books:

1. C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4th Edition, 2018.
2. Ranjit Kumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3rdEdition, 2011.
3. Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.
4. N. K. Acharya, Textbook on Intellectual Property Rights, 4th Edition, Asia Law House, Hyderabad

26PCSE151 Block Chain Technology (42-0-0-48) 3

Contact Hours: 90

Objectives (CLOs):

This course focuses on understanding emerging abstract models for Blockchain Technology and familiarizes the functional/operational aspects of the crypto currency ecosystem. Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** the role of Block chain Technology in the real world.		3, 4, 5 1	1
CO-2	**Analyze** and understand the role of cryptography in block chain technology.	-	3,5	-
CO-3	**Evaluate** the usage of Block chain implementation features, using different cryptocurrencies.	1	1, 3, 4	-
CO-4	**Demonstrate** the usage of bitcoins and its impact on the economy.	3	-	-
CO-5	**Build** a Private Ethereum Network and write smart contracts for decentralized applications.	3	2	6

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**1.5**	**2.0**	**2.4**	**2.0**	**2.0**	**1.0**

Prerequisites: Programming and Data Structures, Cryptography, Computer Networks

Contents:

1 **Introduction to Blockchain**: Centralized vs. Decentralized Systems, Layers of Blockchain, why is Blockchain Important, Blockchain Uses and Use Cases.

08Hrs

2	**Wallets and key management**-Consensus Mechanisms: Proof of Work (PoW), Proof of Stake (PoS), Delegated PoS (DPoS), Practical Byzantine Fault Tolerance (PBFT), Consensus challenges and scalability issues. Cryptocurrencies & Tokens: Bitcoin architecture and transactions, Ethereum basics and Token standards: ERC-20, ERC-721 (NFTs), Mining and validation, Crypto economics	**09Hrs**
3	**Blockchain Architecture**: versions, variants, use cases, Life use cases of Blockchain, Blockchain vs. shared Database, Introduction to crypto currencies, Types, Applications. Concept of Double Spending, Hashing, Mining, Proof of work. Introduction to Merkel tree, Privacy, payment verification, Resolving Conflicts, Creation of Blocks.	**08Hrs**
4	**How Bitcoin Works:** The Bitcoin Blockchain, The Bitcoin Network, Bitcoin Scripts, Bitcoin Wallets, Blockchain vs. Bitcoin, Practical applications. Interacting with the Bitcoin Blockchain.	**08Hrs**
5	**How Ethereum Works:** From Bitcoin to Ethereum, Enter the Ethereum Blockchain, Ethereum Smart Contracts, Ethereum Virtual Machine and Code Execution, Interacting Programmatically with Ethereum- Sending Transactions	**09Hrs**

Reference Books:

1. Arshdeep Bikramaditya Signal, Gautam Dhameja (Priyanshu Sekhar Panda., A Press.) "Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions" 2018
2. Bahga, Vijay Madisetti "Blockchain Applications: A Hands-On Approach" Melanie Swan, OReilly "Block chain". 2017
3. Aravind Narayan. Joseph Bonneau, princeton "Bitcoin and Cryptocurrency Technologies" 2016
4. Arthur.T Books "Bitcoin and Blockchain Basics: A non-technical introduction for beginners" 2019
5. https://www.guru99.com/blockchain-tutorial.html
6. https://developer.ibm.com/technologies/blockchain/gettingstarted/

26PCSE152 Image and Video Analytics (42-0-0-48) 3

Contact Hours: 90

Course Learning Objectives (CLOs):

This course is designed for post graduate level as an elective course, focuses on the principles, concepts, and representations in image and video analytics.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course, the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Apply** preprocessing techniques for better understanding of images	-	3,4	-
CO-2	**Apply** spatial filtering to images for the preprocessing purposes	-	3,4	-
CO-3	**Apply** color transformations to image and video data	-	3,4	-
CO-4	**Apply** detection and classification methods for image and video data analytics	-	3,4	-
CO-5	**Apply** and analyze the techniques through case studies	-	3,4,5	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**-**	**-**	**2.0**	**2.0**	**2.0**	**-**

Pre-requisites: Knowledge of: Basics of statistics, Linear Algebra, computer graphics

Contents:

1. **Digital image representation**- Visual Perception- Sampling and Quantization- Basic Relations between Pixels- Mathematical Tools Used in Digital Image Processing: Fundamental Operations –Vector and Matrix Operations- Image Transforms (DFT, DCT, DWT, Hadamard). **8Hrs**

2. **Fundamentals of spatial filtering**: spatial correlation and convolution-smoothing blurring- sharpening- edge detection - Basics of filtering in the frequency domain: smoothing-blurring- sharpening--Histograms and basic statistical models of image **8Hrs**
3. **Detection of Objects:** Detection of Objects of Interest, Tracking of Objects of Interest in a Sequence of Images, Tracking Objects of Interest Through a Camera Network. **9Hrs**
4. **Biometric Techniques:** Biometric Techniques Applied to Video Surveillance, Activity Recognition: Vehicle Recognition in Video Surveillance **9Hrs**
5. **Unsupervised Object Detection**: Unsupervised Methods for Activity Analysis and Detection of Abnormal Events, Analysis of Crowded Scenes in Video, Detection of Visual Context, Example of an Operational Evaluation Platform: PPSL **8Hrs**

Reference Books:

1. R.C. Gonzalez, R.E. Woods, “Digital Image Processing”, Pearson, 2009
2. Jean-Yves Dufour, “Intelligent Video Surveillance Systems”, Wiley, 2013
3. Rick Szelisk, “Computer Vision: Algorithms and Applications”, Springer, 2011
4. Härdle W, Müller M, Sperlich S, Werwatz, A, “Nonparametric and Semi parametric Models”, Springer, 2004

26PCSE153 High Performance Computing (42-0-0-48) 3

Contact Hours: 90

Course Learning Objectives (CLOs):

This 52-hour course intends to provide introductory knowledge of parallel architecture, design and analysis of parallel algorithms and parallel programming.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the need for parallelism with scientific and business applications and scope for parallel computing.	1,3	2	5
CO-2	**Estimate** the performance of computing systems using Amdahl's law and SPEC rating.	1	2	-
CO-3	**Evaluate** parallel computing models and communication mechanisms, and design suitable parallel algorithms.	1	-	6
CO-4	**Apply** the design principles of parallel algorithms.	3	2	-
CO-5	**Write** and **execute** the MPI and Open MP programs.	2	-	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**3.0**	**2.4**	**2.0**	**-**	**1.0**	**1.0**

Pre requisites:

1. Computer Organization
2. High level Programming course
3. Assembly Language Programming

Contents:

1. **Introduction to parallel computing:** Motivating Parallelism, Scope for Parallel Computing; Flynn's classification of architectures. Need for parallel computers Models of computation Analyzing parallel algorithms Expressing parallel algorithms.
   Self-Study: High end processors, GPUs etc. **07 Hrs**
2. **Performance Measurement Techniques:** Benchmark programs, SPEC ratings, Amdahl's law, Gustaffsons law. **07 Hrs**
3. **Parallel Programming Platform:** Implicit parallelism, Limitations of Memory System Performance, Dichotomy of Parallel Computing, Physical organization of Parallel Platforms, Communication Costs in Parallel Machines, Inter Connection Networking and Routing. **07 Hrs**
4. **Principles of Parallel Algorithm Design:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping techniques for load balancing, Methods for Containing Interaction Overhead, Parallel Algorithm Models. **07 Hrs**
5. **Message Passing Programming:** Message passing Model, Message Passing Interface, Circuit Satisfiability, (MPI_Init, MPI_Comm_rank, MPI_Comm_size, MIP_Finalize, Compiling and Running MPI Programs), Introducing Collective Communication. **07 Hrs**
6. **Shared Memory Programming:** Parallel for loop, declaring private variables, critical sections, Reductions, performance improvements, General data parallelisms **07 Hrs**

Reference Books:

1. Anant Grama, Anshul Gupta, George Karpis,Vipin Kumar, Introduction to Parallel Computing: second edition, Pearson, 2011
2. Michel J Quinn "Parallel Programming in C with MPI and OpenMP" 2009 Tata McGrawHill
3. Charles Severence and Kevin Dowd, High Performance Computing, O'Reily Media 1998

II Semester

26PCSC201 Deep Learning (42-28-0-50) 4

Contact Hours: 120

Objectives (CLOs): This course focuses on

- To provide foundational understanding of deep learning architectures including feedforward, convolutional, and sequence models.
- To develop knowledge of optimization techniques, regularization strategies and challenges involved in training deep neural networks.
- To enable learners to understand and analyze advanced deep learning concepts and research trends.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** deep feed forward networks and regularization techniques to design models with improved generalization.	3	1	6
CO-2	**Evaluate** optimization algorithms and strategies to effectively train deep neural networks.	-	1	6
CO-3	**Analyse** and **Apply** convolutional neural network concepts to design models for spatial and sequential data processing.	3	1,2	5,6
CO-4	**Apply** sequence modelling techniques using RNNs and their variants to process and learn from sequential data.	-	1,2	5.6
CO-5	**Explain** advanced concepts such as auto encoders, representation learning, and research trends in deep learning.	-	-	6

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**2.0**	**2.0**	**3.0**	**-**	**1.0**	**1.0**

Pre requisites: Knowledge of Linear Algebra, probability and Machine Learning

Contents:

1 **Deep Feed forward Networks and Regularization for Deep Learning:** Introduction to Neural Network, Overview of Deep Feedforward network. Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under- Constrained Problem, Dataset Augmentation, Noise Robustness, Semi-Supervised Learning, Multi- Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging and Other Ensemble Methods, Dropout, Adversarial Training **10Hrs**

2 **Optimization for Training Deep Models:** How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms, Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates, Approximate Second-Order Methods, Optimization Strategies and Meta-Algorithms **10Hrs**

3 **Convolution Neural Networks:** The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Unsupervised Features, The Neuroscientific Basis for Convolutional Networks, Convolutional Networks and the History of Deep learning. State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other Gated RNNs, Optimization for Long- Term Dependencies, Explicit Memory **10Hrs**

4 **Sequence Models: Recurrent and Recursive Nets (RNN) :** Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder- Decoder Sequence-to-Sequence Architectures, Recursive Neural Networks, The Challenge of Long-Term Dependencies, Echo State Networks, Leaky Units and Other Strategies for Multiple Time Scales, The Long Short-Term Memory and Other GatedRNNs, Optimization for Long- Term Dependencies, Explicit Memory **11Hrs**

5 **Deep Learning Research :** Linear Factor Models, Autoencoders; Data Types, Efficient convolution Algorithms, Random forest, Probabilistic PCA and Factor Analysis, Independent Component Analysis (ICA), Sparse Coding, Undercomplete Autoencoders, Regularized Autoencoders, Representational Power, Layer Size and

Depth, Stochastic Encoders and Decoders, Denoising Autoencoders, Learning Manifolds with Autoencoders, Contractive Autoencoders, Predictive Sparse Decomposition, Applications of Autoencoders. **11 Hrs**

Reference Books:

1. Deep Learning, Ian Goodfellow and Yoshua Bengio and Aaron Courville, An MIT Press book,2016
2. Deep Learning with Python, Francois Chollet, Manning Publications,2017, ISBN 10, 9781617294433.
3. Dive into Deep Learning Release 0.8.0 Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola, 2020.
4. Neural Networks and Deep Learning - Charu Aggarwal, Springer Nature Switzerland AG 2018, 2023

26PCSC202 Edge Computing (42-0-0-48) 3

Contact Hours: 90

Learning Objectives (CLOs):

This course aims to provide students with a comprehensive understanding of modern edge environments. It helps learners to understand need for edge computing.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** edge computing architectures, networking interfaces, and background Internet of Things (IoT) devices using SOTA simulators	-	3,5,6	1,2
CO-2	**Formulate** edge analytics architectures and integrate machine learning models directly onto edge devices for real-time application processing	-	3,5,6	1,2
CO-3	**Evaluate** and apply robust security protocols and privacy preserving schemes to detect and prevent attacks in decentralized edge environments	-	3,5,6	1,2
CO-4	**Apply** distributed ledger technology to design, validate, and integrate secure block chain platforms within IoT edge systems	-	3,5,6	1,2
CO-5	**Explore** high potential edge computing use cases across various domains that ensure secure data storage at the edge	-	3,5,6	1,2

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**1.0**	**1.0**	**2.0**	**-**	**2.0**	**2.0**

Pre requisites: Knowledge on Cloud Computing and Internet of Things

Contents:

1	**Edge Computing and its essentials**: Introduction, edge computing architecture, background essentials, networking architecture, network management and control, edge computing SOTA interfaces and devices, edge computing simulators, research directions	**8 Hrs**
2	**Edge Analytics:** types of data, data analytics, goals of data analytics, domains benefitting from big data analytics, real time applications of data analytics, phases of data analytics, types of data analytics, edge data analytics, potential of edge analytics, architecture and potential of edge analytics, machine learning for edge analytics, edge analytics: case study, research challenges and future research directions	**9 Hrs**
3	**Edge Data Storage Security**: data security, data confidentiality, authentication, privacy preserving schemes, edge-based attack detection and prevention, future research directions	**8 Hrs**
4	**Block chain and Edge Computing Systems**: history of blockchain, distributed ledger; role of P2P architecture in blockchain, blockchain cryptography, characteristics of blockchain, benefits and limitations of block chain, types of block chain, blockchain architecture and fundamentals, blockchain platforms, edge computing with blockchain, research challenges	**9 Hrs**
5	**Edge Computing Use Cases and Case Studies:** use cases, Edge Computing High-Potential Use Cases, Realization of Edge Computing in Healthcare Ensuring Storage Security, open research challenges	**8 Hrs**

Reference Books:

1. Edge Computing: Fundamentals, Advances and Applications, K. Anitha Kumari, G. Sudha Sadasivam, et al, CRC Press / Taylor & Francis, October 2024
2. Fog and Edge Computing: Principles and Paradigms, Rajkumar Buyya and Satish Narayana Srirama (Wiley) 2019
3. Internet of Things and Edge Computing for Architects, Perry Lea, Packt Publishing 2020
4 Edge Computing: Models, Technologies and Applications, Springer, 2021

26PCSC203 Network and Cyber security (42-0-0-48) 3

Contact hours:90

Course Learning Objectives (CLOs)

The course equips students with knowledge of cyber security principles, network and system protection, vulnerability analysis, and ethical hacking, while enabling them to design secure solutions and address emerging security challenges with ethical and research-oriented approaches.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 6)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Analyze** cyber threats and apply cryptographic techniques	-	3	-
CO-2	**Design** and secure network systems	1	3	4
CO-3	**Identify** vulnerabilities in applications and OS	1	3	4
CO-4	**Apply** penetration testing and analyze malware analysis	1	3	4
CO-5	**Implement** incident response and modern security frameworks	1	3	4

Mapping Level:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	3	-	2	1	-	-

Pre requisites: Basic Knowledge of Computer Networks.

Contents

1. **Fundamentals of Cyber Security & Cryptography** Introduction to Cyber Security: Goals, challenges, threat landscape. Security principles: CIA triad, AAA, risk management. Types of attacks: passive vs active, insider threats, social engineering. Cryptography fundamentals: Symmetric encryption (AES, DES), Asymmetric encryption (RSA, ECC), Hash functions (SHA family), MAC. Public Key Infrastructure (PKI), Digital Signatures, Certificates. Key **8Hrs**

management and distribution

2. **Network Security & Protocols**: Network vulnerabilities and threat modelling. TCP/IP security issues: Secure communication protocols: SSL/TLS, HTTPS, IPSec architecture (AH, ESP), VPNs and tunnelling. Firewalls: packet filtering, stateful, next-gen firewalls. Intrusion Detection & Prevention Systems (IDS/IPS). Wireless network security (WEP, WPA2, WPA3 issues) . Network monitoring tools (Wireshark, Snort) **9Hrs**
3. **System, Application & Web Security:** Operating system security: Access control models (DAC, MAC, RBAC), File system security, patch management. Software & application security: Secure coding practices, OWASP Top 10 vulnerabilities. Web security: SQL Injection, XSS, CSRF, Session management attacks. Buffer overflow and exploitation techniques, Secure software development lifecycle (SSDLC) **8Hrs**
4. **Cyber Attacks, Ethical Hacking & Malware Analysis:** Cyber-attack lifecycle: Ethical hacking methodology, Penetration testing tools: Nmap, Metasploit, Burp Suite. Malware types: virus, worm, ransomware, spyware. Static & dynamic malware analysis, Reverse engineering basics. Case studies of real-world cyber attacks **9Hrs**
5. **Advanced Security, Incident Response & Emerging Trends:** Incident response lifecycle: detection, containment, recovery. Digital forensics basics and evidence handling. Security Information and Event Management (SIEM). Cloud security fundamentals. IoT security challenges. Zero Trust Architecture. Blockchain security basics. Cyber laws, ethics, and compliance (ISO 27001, NIST). **8Hrs**

Reference Books:

1. William Stallings, Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson,2020 (© 2021)
2. Charlie Kaufman, Radia Perlman, Mike Speciner of Network Security: Private Communication in a Public World, 3rd Edition, Addison-Wesley Professional (Pearson) 2022 (© 2023).
3. Behrouz A. Forouzan entitle Cryptography and Network Security, Publisher: McGraw-Hill Education 3rd Edition (Indian Edition) – 2015 (with Debdeep Mukhopadhyay)
4. William Stallings & Lawrie Brown – Computer Security: Principles and Practice 4th edition Pearson 2018

26PCSL207 Deep Learning Lab (0-0-24-6) 1

Contact Hours: 30

Course Learning Objectives (CLOs):

This course focuses on, Acquiring knowledge of deep learning architectures, frameworks, and model development techniques. It enables them to design, implement, and optimize deep learning models using advanced methods such as CNNs, RNNs/LSTMs, and transfer learning for real-world applications.

Course Outcomes (CO's):

CO	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs (1 to 6)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO 1	**Implement** and train deep neural network models using modern deep learning frameworks such as TensorFlow, Keras, or PyTorch.	3	1,2,4	-
CO 2	**Develop** CNN-based solutions for image classification and computer vision applications.	3	1,2,4	-
CO 3	**Build** and evaluate RNN/LSTM-based models for sequence learning, natural language processing, and time-series forecasting.	3	1,2,4	-
CO 4	**Analyze** model performance, apply optimization techniques, and develop deep learning solutions for real-world problems.	3	1,2,4	-

Mapping Level:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.0	2.0	3	2.0	-	-

Laboratory exercises:

Implementation using MatLab25b, Python + TensorFlow / PyTorch + Scikit-learn + Jupyter Notebook/Google Colab.

Deep Feedforward Networks

1. Implementation of Basic Perceptron

Objective: Understand neuron model and binary classification.

Experiment:

- Implement single-layer perceptron
- Train for AND, OR gates
- Observe decision boundaries

Outcome: Understand weighted sum, activation function, thresholding

2. Multilayer Perceptron for XOR Learning

Objective: Learn non-linear separability.

Experiment:

- Implement MLP with one hidden layer
- Train network for XOR problem
- Compare with single-layer perceptron failure

Tasks: Vary hidden neurons, Compare sigmoid vs ReLU

Outcome: Understand hidden layer importance

3. Comparison of Hidden Units

Objective: Study activation functions.

Experiment:

Train identical MLPs using:

- Sigmoid, Tanh, ReLU, Leaky ReLU,

Compare: Accuracy, Convergence speed, Vanishing gradient behavior

4. Architecture Design Experiment

Objective: Study network depth and width.

Experiment:

Train multiple architectures:

- 1 hidden layer ,3 hidden layers, 5 hidden layers,

Vary neurons: 32, 64, 128

Compare: Accuracy, Overfitting, Training time

Regularization and Optimization

5. L1 / L2 Regularization Experiment

Objective: Study parameter norm penalties.

Experiment:

Train neural network with:

- No regularization, L1 regularization, L2 regularization

Compare: Weight magnitude, Accuracy, Overfitting

6. Dropout Regularization
Objective: Prevent overfitting.
Experiment:
Train CNN / MLP:
- Without dropout
- With dropout rates: 0.2, 0.5

Compare validation performance

7. Early Stopping Implementation
Objective: Study optimization stopping criteria.
Experiment:
- Train deep model for many epochs
- Apply early stopping
- Compare validation loss trends

8. Data Augmentation and Noise Robustness
Objective: Improve generalization.
Experiment:
Use image dataset: Rotation, Flipping, Noise addition, Scaling
Compare accuracy before/after augmentation
Dataset: MNIST Handwritten Digits Dataset or CIFAR-10 Dataset

9. Optimization Algorithm Comparison
Objective: Compare training algorithms.
Train same model using: , SGD, Momentum, RMSProp, Adam, AdaGrad
Compare: Convergence speed, Final accuracy

Convolutional Neural Networks

10. Basic CNN for Image Classification
Objective: Understand convolution and pooling.
Experiment:
Build CNN with: Convolution layer, Pooling layer, Fully connected layer
Dataset: MNIST Handwritten Digits Dataset / Fashion-MNIST Dataset

11. CNN Architecture Comparison
Objective: Study CNN variants.
Compare: Basic CNN, LeNet-5, AlexNet, VGGNet
Evaluate: Parameters, Accuracy, Training time

12. Transfer Learning using Pretrained CNN
Objective: Learn practical deployment.
Use pretrained: ResNet-50, MobileNet
Perform custom image classification

Sequence Models (RNN)

13. Basic RNN for Sequence Prediction
Objective: Learn temporal modeling.
Experiment: Predict next character/word, Time-series prediction
Dataset: Text or stock/time series dataset

14. LSTM for Sentiment Analysis
Objective: Learn long-term dependency handling.
Dataset: IMDB Movie Reviews Dataset
Tasks: Build LSTM network, Compare with vanilla RNN

15. Bidirectional RNN Implementation
Objective: Learn context learning.
Applications: Text classification, Speech recognition

26PCSE241 Agile Technology (42-0-0-48) 3

Contact Hours: 90

Course Learning Objectives (CLOs):

This course is at post graduate level for 4 credits, 42 contact hours with emphasis on the various practical aspects of agile development for building valuable software. This course deals with how to adopt XP practices, describes each practice in detail.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the core principles of adopting agile Development and its benefits.	-	3,4,5,6	-
CO-2	**Explain** the core principles of pair programming and its benefits.	-	3,4,5,6	-
CO-3	**Explain** the importance of documentation.	-	3,4,5,6	-
CO-4	**Explain** the procedure to prepare product design and architecture from agile perspectives.	-	3,4,5,6	-
CO-5	**Explain** the core components of product road map.	-	3,4,5,6	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**-**	**-**	**2**	**2**	**2**	**2**

Pre requisites:

Software Engineering principles and computer programming experience

Contents:

1 **Need for Agile:** Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, **How to Be Agile:** Agile Methods, Don't Make Your Own Method, The Road to **08Hrs**

Mastery, Find a Mentor

2 **Understanding XP:** The XP Lifecycle, The XP Team, XP Concepts, **Adopting XP:** Is XP Right for Us? Challenge for change. **08Hrs**

3 **Practicing XP:** Thinking: Pair Programming, Energized Work, Informative Workspace, Root-Cause Analysis, Retrospectives.

Collaborating: Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand-Up Meetings, Coding Standards, Iteration Demo, Reporting.

Releasing: "Done", No Bugs, Version Control, Ten-Minute Build, Continuous Integration, Collective Code Ownership, Documentation.

Planning: Vision, Release Planning, The Planning Game, Risk Management, Iteration Planning, Slack, Stories, Estimating. Developing: Incremental requirements, Customer Tests, Test-driven Development, Refactoring, Simple Design, Incremental Design and Architecture, Spike Solutions, Performance Optimization, Exploratory Testing. **10Hrs**

4 **Mastering Agility-1:** Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading.

Improve the Process: Understand Your Project, Tune and Adapt, Break the Rules.

Rely on People: Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People.

Eliminate Waste: Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput. **08Hrs**

5 **Mastering Agility-2:**

Deliver Value: Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently,

Seek Technical Excellence: Software Doesn't Exist, Design Is for Understanding, Design Trade-offs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery **08Hrs**

Reference Books:

1. James Shore and Shane Warden, "The Art of Agile Development"- O'Reilly Publications-2007
2. Robert C. Martin, "Agile Software Development, Principles, Patterns, and Practices" Prentice Hall 1st edition, 2002

26PCSE242 Software Project Management Tools (42-0-0-48) 3

Contact Hours: 90

Course Learning Objectives (CLOs):

This course is emphasis on practice-based learning. Student gets mastery on the various standards, procedures and industry relevant tools for effective management of scope, time, costs, and quality, ensuring satisfying the needs for which the project was undertaken.

Course Outcomes (COs):

CO	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs (1 to 6)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Use** appropriate metrics to manage the software development outcome.	3,4,6	1,2, 5	-
CO-2	**Identify** the various risk for the given project and propose mitigation plan	3,4,6	1,2, 5	-
CO-3	**Use** industry relevant project configuration management tool	3,4,6	1,2, 5	-
CO-4	**Estimate** the cost and resource required for the given project specification.	3,4,6	1,2, 5	-
CO-5	**Use** tools to monitor the project progress in terms of targets, slippage, resources & revision.	3,4,6	1,2, 5	-
CO-6	**Develop** comprehensive project plan.	3,4,6	1,2, 5	-

Mapping level:

POs/PSOs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	2.0	2.0	3.0	3.0	2.0	3.0

Prerequisites: Software Engineering.

Contents:

1 **Metrics**: Introduction, The Metrics Roadmap, A Typical Metrics Strategy, What Should you Measure?, Set Targets and track Them, Understanding and Trying to minimize variability, Act on data, People and Organizational issues in Metrics Programs, Common Pitfalls to watch out for in Metrics Programs, Matrices implementation checklists and tools.

Software configuration management: Introduction, Some Basic Definitions and terminology, the processes and activities of software configuration management, configuration status accounting, configuration audit, software configuration management in geographically distributed teams, Metrics in software configuration management, software configuration management tools and automation. **08 Hrs**

2 **Risk Management**: Introduction, What is risk management and why is it important?, Risk management cycle, Risk identification: common tools and techniques, Risk Quantifications, Risk Monitoring, Risk Mitigation, Risks and Mitigation in the context of global project teams, some practical techniques risk management, Metrics in risk management.

Project Planning and Tracking: Components of Project Planning and Tracking, The “What “ Part of a Project Plan, The “What Cost “ Part of a Project Plan, The “When “ Part of Project Planning, The “How “ Part of a Project Planning: Tailoring of Organizational Processes For the Project, The “ By Whom “ Part of the Project Management Plan : Assigning Resources, Putting it all together : The Software Management Plan, Activities Specific to Project Tracking, Interfaces to the Process Database. Project Closure: When Does Project Closure Happen?. Why Should We Explicitly do a Closure?, An Effective Closure Process, Issues that Get Discussed During Closure, Metrics for Project Closure, Interfaces to the Process Database. **09 Hrs**

3 **Software Requirements gathering**: Inputs and start criteria for requirements gathering, Dimensions of requirements gathering, Steps to be followed during requirements gathering, outputs and quality records from the requirements phase, skill sets required during requirements phase, differences for a shrink-wrapped software, challenges during the requirements management phase, Metrics for requirements phase.

Estimation: What is Estimation? when and why is Estimation done?, the three phases of Estimation, Estimation methodology, formal models for size Estimation, Translating size Estimate into effort Estimate, Translating effort Estimates into schedule Estimate, common challenges during Estimation , Metrics for the Estimation processes. **09 Hrs**

4 **Design and Development Phases**: Some differences in our chosen approach, salient features of design, evolving an architecture/ blueprint, design for reusability, technology choices/ constraints, design to standards, design for portability, user interface issues, design for testability, design for diagnose ability, design for maintainability, design for install ability, inter-operability design, challenges during design and development phases, skill sets for design and development, metrics for design and development phases.

Project management in the testing phase: Introduction, What is testing?, what are the activities that makeup testing?, test scheduling and types of tests, people issues in testing, management structures for testing in global teams, metrics for testing phase. **08 Hrs**

5 **Project management in the Maintenance Phase**: Introduction, Activities during Maintenance Phase, management issues during Maintenance Phase, Configuration management during Maintenance Phase, skill sets for people in the maintenance phase, estimating size, effort, and people resources for the maintenance phase, advantages of using geographically distributed teams for the maintenance phase, metrics for the maintenance phase.

Impact of the internet on project management: Introduction, the effect of internet on project management, managing projects for the internet, Effect on the project management activities. People focused process models: Growing emphasis on people centric models, people capability maturity model (P-CMM), other people focused models in the literature, how does an organization choose the models to use? **08 Hrs**

Reference Books:

1. Watts Humphrey, “Managing the Software Process”, Pearson Education, 2000.
2. Pankaj Jalote, “Software Project Management in practice”, Pearson Education, 2002.
3. Ramesh Gopalaswamy, “Managing Global Projects”, Tata McGraw Hill, 2013.

26PCSE243 Software Engineering and DevOps (42-0-0-48) 3

Contact Hours:90

Objectives (CLOs):

The course aims to introduce students to the fundamental concepts and terminology of DevOps, along with an understanding of modern DevOps platforms. It focuses on building and deploying code efficiently while providing hands-on exposure to automation tools used in the DevOps ecosystem. The course also enables learners to develop practical skills for continuous integration, delivery, and deployment in real-world environments.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** components of DevOps environment.	-	1,2	6
CO-2	**Describe** Software development models and architectures of DevOps.	-	3,2	6
CO-3	**Apply** different project management, integration, testing and code deployment tool.	3,4	2	6
CO-4	**Describe** different DevOps Software development models	-	2	6
CO-5	**Assess** various DevOps practices, Collaborate and adopt DevOps in real-time projects.	3	2	6

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**2.0**	**2.0**	**2.6**	**3.0**	**-**	**1.0**

Pre requisites: Knowledge of software development life cycle, Software Models and Project management tools.

Contents:

1	**Introduction:** Introduction, Agile development model, DevOps, and ITIL DevOps process and Continuous Delivery, Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples	**09 Hrs**
2	**Software development models and DevOps:** DevOps Lifecycle for Business Agility, DevOps, and Continuous Testing. DevOps influence on Architecture: Introducing software architecture, The monolithic scenario, Architecture rules of thumb, The separation of concerns, Handling database migrations, Micro services, and the data tier, DevOps, architecture, and resilience.	**09 Hrs**
3	**Introduction to project management:** The need for source code control, the history of source code management, Roles and code, source code management system and migrations, Shared authentication, Hosted Git servers, Different Git server implementations, Docker intermission, Gerrit, The pull request model, GitLab.	**08 Hrs**
4	**Integrating the system:** Build systems, Jenkins build server, managing build dependencies, Jenkins plugins, and file system layout, the host server, Build slaves, Software on the host, Triggers, Job chaining and build pipelines, Build servers and infrastructure as code, Building by dependency order, Build phases, Alternative build servers, Collating quality measures.	**08 Hrs**
5	**Testing Tools and automation:** Various types of testing, Automation of testing Pros and cons, Selenium - Introduction, Selenium features, JavaScript testing, testing backend integration points, Test-driven development, REPL-driven development Deployment of the system: Deployment systems, Virtualization stacks, code execution at the client, Puppet master and agents, Ansible, Deployment tools: Chef, Salt Stack and Docker	**08 Hrs**

Reference Books:

1. Joakim Verona. Practical Devops, Second Edition. Ingram short title; 2nd edition (2018). ISBN10: 1788392574
2. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952
3. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10.
4 Deepak Gaikwad, Viral Thakkar, DevOps Tools From Practitioner’s Viewpoint, Wiley 2019
5. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012.

26PCSE251 Data Science & Applications (42-0-0-48) 3

Contact Hours: 90

Objectives (CLOs):

This course focus on the concepts of Data Science and Engineering and working principles of industry relevant tools and applications developed in different domain.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the data science project life cycle and its applications	-	1	2
CO-2	**Apply** preprocessing methods and visualization techniques to get insight about the data.	3,4,6	-	-
CO-3	**Evaluate** classification techniques, associated challenges, and classifier performance using appropriate metrics.	3,4,6	-	-
CO-4	**Evaluate** the clustering techniques, different metrics and identification of anomalies	3,4,6	-	-
CO-5	**Apply** graph representations to model and study social networks	3,4,6	-	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**2**	**1**	**3**	**3**		**3**

Prerequisites: Knowledge of Statistics

Contents:

1 **Introduction to data science**: Introduction to Data Science – History of Data Science – Relationship between Data Warehouse – Big Data and Data Science –Scope of Data Science – Data Science with other fields – Relationship between Data Science and Information Science. Data: Data Types-Structured Vs. Unstructured data –Quantitative vs. Qualitative data-The Four Levels of Data-Data Collection-Data Pre- **8 Hrs**

Processing- Roles and Responsibilities of a data scientist- Data Science concerns

2 **Data science process and data analysis**: Data Science Process: Prior Knowledge - Data Preparation -Modeling - Application – Knowledge. Data Collections: Open Data-Social Media Data-Multimodal data- Data storage and Presentation-Data Preprocessing: Data Cleaning-Data Integration-Data Transformation-Data Reduction-Data Discretization-Data Analysis and Data Analytics: Descriptive analysis- Diagnostic Analytics- Predictive Analytics- Prescriptive analysis - Exploratory analysis -Mechanistic analysis **12 Hrs**

3 **Data Science In Spreadsheet**: Introduction to Basic functions of Spreadsheet– Data Collection and Preparation – Importing Data into Spreadsheet from Different Data Sources –Data Cleaning and Preliminary Data Analysis – Correlation and importance of variables technical requirements- Data Visualization in Spreadsheet – Pivot Tables and Charts-VLOOKUP-Dashboard in Spreadsheet **12 Hrs**

4 **Data visualization**: Data Exploration - Objectives of data Exploration - Datasets - Descriptive Statistics - Data Visualization - Roadmap for data exploration -Data Visualization Tools-Tools for Data Science-Importing Matplotlib – Line plots – Scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three-dimensional plotting – Geographic Data with Basemap – Visualization with Seaborn and Tableau. **12 Hrs**

5 **Domain-Specific Applications**: Healthcare analytics (disease prediction), Financial analytics (stock prediction, risk modeling), Smart agriculture (precision farming), Cybersecurity analytics, Recommendation systems (Netflix, Amazon) **12 Hrs**

Text Books:

1. Sinan Ozdemir, “Principles of Data Science”, Packt Publication, 2016.
2. Chirag Shah, “A Hands-on Introduction to Data Science”, Cambridge University Press, 2020.
3. Vijay Kotu, Bala Deshpande, “Data Science: Concepts and Practice”, Second Edition, Elsevier Publications, 2019.
4. Cathy O’Neil and Rachel Schutt. “Doing Data Science, Straight Talk from The Frontline” O’Reilly Media, Inc. 2013
5. Healthcare Data Analytics Chandan K. Reddy, Charu C. Aggarwal Chapman & HALL Year: 2024

26PCSE252 Analysis of Computer Networks (42-0-0-48) 3

Contact hours:90

Course Learning Objectives (CLOs):

The course Analysis of Computer Networks focuses on understanding network architectures, protocols, and performance metrics such as latency, throughput, and bandwidth. It develops the ability to analyze network behavior using mathematical models and evaluate issues like congestion control, reliability, and fault tolerance. The course also emphasizes designing efficient network topologies and using simulation tools to study real-world networking scenarios, enabling students to propose optimized solutions for network performance.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to Pos (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the quantitative modeling in the Computer Networks.	-	3	-
CO-2	**Explain** Network performance and source characterization	-	4	-
CO-3	**Differentiate** network services, protocols, and architectures, and justify their layered organization.	-	3, 4	-
CO-4	**Implement** key Internet applications and their protocols, and will apply to develop their own applications using the sockets API	3	2	-
CO-5	**Illustrate** adaptive Bandwidth Sharing for Elastic Traffic: Elastic transfers in a Network.	3, 4	2	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**-**	**2.0**	**2.5**	**2.33**	**-**	**-**

Pre requisites:

Knowledge of Computer Networks

Contents:

1	**Introduction to network analysis**: Efficient transport of packet voice calls, Achievable throughput in an input-queuing packet switch; the importance of quantitative modeling in the Engineering of Telecommunication Networks.	**9Hrs**
2	**Multiplexing:** Network performance and source characterization; Stream sessions in a packet network: Delay guarantees; Elastic transfers in a packet network; Packet multiplexing over Wireless networks.	**9 Hrs**
3	**Stream Sessions and Deterministic Network Analysis:** Events and processes in packet multiplexer models: Universal concepts; Deterministic traffic models and Network Calculus; Scheduling; Application to a packet voice example; Connection setup: The RSVP approach; Scheduling	**8Hrs**
4	**Stream Sessions and Stochastic Analysis**: Deterministic analysis can yield loose bounds; Stochastic traffic models; Additional notation; Performance measures; Little's theorem, Brumelle's theorem, and applications; Multiplexer analysis with stationary and ergodic traffic; The effective bandwidth approach for admission control; Application to the packet voice example; Stochastic analysis with shaped traffic; Multihop networks; Long-Range-Dependent traffic	**8Hrs**
5	**Adaptive Bandwidth Sharing for Elastic Traffic**: Elastic transfers in a Network; Network parameters and performance objectives; sharing a single link; Rate-Based Control; Window-Based Control: General Principles; TCP: The Internet's Adaptive Window Protocol; Bandwidth sharing in a Network.	**8 Hrs**

Reference Books:

1. Communication Networking An Analytical Approach Anurag Kumar, D. Manjunath, Joy Kuri Elsevier,2014
2. Broadband Integrated Networks M. Schwartz Prentice Hall,2006
3. High Performance Communication Networks J. Walrand, P. Varaiya, Morgan Kaufmann, 2nd Edition, 2009

26PCSE253 Big Data & AI Applications (42-0-0-48) 3

Contact Hours: 90 hours

Objectives (CLOs):

- To introduce the fundamentals of big data and its role in AI-driven applications.
- To explore big data tools and technologies such as Hadoop, Spark, and NoSQL databases.
- To demonstrate use cases of big data in domains like healthcare, finance, and IoT using AI

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the architecture and ecosystem of big data processing.	-	3	-
CO-2	**Analyze** and manage large-scale datasets using Hadoop and Spark.	-	3	-
CO-3	**Apply** AI/ML techniques to extract insights from big data.	-	3,5	-
CO-4	**Design** and implement scalable data pipelines using distributed frameworks.	1,4	5	6
CO-5	**Solve** real-world domain problems with AI-powered big data solutions.	1,4	5	6

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**3.0**	**-**	**2.0**	**3.0**	**2.0**	**1.0**

Pre requisites: Database concepts, Any Programming, Unix Shell commands

Contents:

1 **Introduction to Big Data:** Introduction: Understanding Big data-concepts and terminology, Big Data Characteristics, Different Types of Data. (chapter 1 Big data fundamentals-Thomas Erl) Classification of Analytics, Challenges in Big Data. Big Data Storage: Clusters, File Systems and Distributed File Systems, **08Hrs**

NoSQL. Big Data Technologies: Parallel Data Processing, Distributed Data Processing, Hadoop, NoSQL Databases

2 **Big Data Tools and NoSQL:** Introduction: Hadoop Ecosystem, HDFS Commands, MapReduce, Pig, Flume, Sqoop, Mahout, The Machine Learning Platform from Apache, GANGLIA, The Monitoring Tool, Kafka, The Stream Processing Platform Spark. NoSQL Data Models- Key-value stores, column-Based stores, graph-Based stores, document-based stores, graph-based stores **08Hrs**

3 **Machine Learning on Big Data:** Predictive Modeling for Unstructured Data: Introduction, Applications of Predictive Modeling, Feature Engineering, Pattern Mining for Predictive Modeling. Machine Learning with MLib: Supervised, unsupervised Learning, ML pipelines, Hyperparameter Tuning. Managing Deploying and Scaling Machine Learning pipelines with Apache Spark. **09Hrs**

4 **AI Applications on Big Data:** Big data and AI systems: Intelligence, Big data frameworks, Intelligent applications with big data. Ontology for big data: human brain and ontology, IOT and big data analytics: smart cities and IOT, Stages of IOT and Stakeholders, Analytics, Big data analytics and IOT, fog computing. Big Data Analytics for Financial Services and Banking. **08Hrs**

5 **Advanced Topics and Case Studies:** Deep big data analytics: Distributed computing, distributed deep learning. Cyber security: Big data for critical infrastructure protection, Stream processing, cyber security attack types. Security in big data, privacy and big data analytics. Big Data Analytics Techniques in Capital Market Use Cases. **09Hrs**

Reference Books:

1 Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals Concepts, Drivers & Techniques, Prentice Hall, 2015.

2 Seema Acharya, Subhashini Chellappan, Big Data &Analytics, Wiley India Pvt Ltd 2014

3 Prabhu, C. S. R., Chivukula, A. S., Mogadala, A., Ghosh, R., & Livingston, L. M. J. (2020). Big Data Analytics: Systems, Algorithms, Applications. Springer Singapore. https://doi.org/10.1007/978-981-15-0094-7

4 Learning Spark: Lightning-Fast Big Data Analysis by Jules S. Damji et al. – O'Reilly

5 Big Data: Principles and Paradigms by Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi – Wiley

6 Deshpande, Anand, and Manish Kumar. Artificial Intelligence for Big Data. Packt Publishing, 2018

26PCSE261 Biomedical Image Processing (42-0-0-48) 3

Contact Hours: 90

Objectives (CLOs):

- Develop foundational knowledge of biomedical instrumentation, including medical terminology, system concepts, and measurement characteristics.
- Understand the generation, acquisition, and analysis of bioelectric signals using electrodes and bio potential amplifiers.
- Gain proficiency in clinical measurement techniques for physiological parameters and biochemical analysis methods.
- Learn the principles and applications of medical imaging, biotelemetry, and telemedicine systems for healthcare monitoring.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Apply** fundamental medical terminology and concepts to understand medical devices and instrumentation systems	-	3,5,6	1,2
CO-2	**Analyze** the generation and propagation of bioelectric signals, cell structure, and applications of biomedical electrodes.	-	3,5,6	1,2
CO-3	**Interpret** the origin of biopotentials, electrical activity of excitable cells, and bio-signal acquisition techniques including EEG, ECG, and EMG.	-	3,5,6	1,2
CO-4	**Evaluate** the principles of medical imaging systems, image formation, and information content, along with basic image processing techniques.	-	3,5,6	1,2
CO-5	**Illustrate** the principles of biotelemetry, its components, signal transmission methods, and suitability for physiological measurements.	-	3,5,6	1,2

Mapping Level:

POs	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6
Mapping Level	1.0	1.0	2.0	-	2.0	2.0

Pre requisites:
Basic knowledge of human physiology and anatomy, along with fundamental concepts of electrical engineering (circuits, signals, and measurements) and basic physics of electricity and waves.

Contents:

1 **Overview of Biomedical Imaging Systems**: Basic concepts of medical instrumentation, Classifications of Biomedical Instruments, Interfering and Modifying Inputs, Compensation Techniques, Biostatistics. Types of Imaging Modalities: X-ray, CT, MRI, Ultrasound, PET, SPECT. Image formats in medical imaging (DICOM standard), Noise models in biomedical images (Gaussian, salt & pepper, speckle). **08Hrs**

2 **Bio-electric signals and electrodes**: Elementary ideas of cell structure, Bio – potential and their generation – Resting and action potential – propagation of action potential. Electrodes – Micro – Skin surface – needle electrodes. Clinical Measurement: Measurement of Blood pressure (direct, indirect) – blood flow meter (Electromagnetic& ultrasonic blood flow meter) – blood pH measurement - Measurement of Respiration rate – measurement of lung volume – heart rate measurement – Measurement of body and skin temperature - Chromatography, Photometry, Flurometry. **08Hrs**

3 **The Origin of Biopotentials**: Electrical Activity of Excitable Cells, Electroneurogram, Electromyogram, Electrocardiogram, Electroretinogram, Electroencephalogram, Magnetoencephalogram, Electrode–Electrolyte Interface, Polarizable and Nonpolarizable Electrodes, Electrode Behavior and Circuit Models, Electrode–Skin Interface and Motion Artifact, Body-Surface Recording Electrodes, Biopotential Amplifiers -Basic Requirements, Problems Frequently Encountered **08Hrs**

4 **Medical imaging systems:** Information Content of an Image, Image Processing, Radiography, Computed Tomography, Magnetic Resonance Imaging, Positron Emission Tomography, Ultrasonography, **09Hrs**

5 **Advanced Topics & Applications**:3D image processing and **09Hrs**

volumetric analysis, Image-guided surgery Radiomics and precision medicine, Ethical considerations in medical imaging Emerging trends (AI-assisted diagnosis)

Reference Books:

1. Medical instrumentation, Application and Design, Edited by John G. Webster and Amit J. Nimunkar, Fifth Edition, John Wiley & Sons, Inc, 2020
2. Biomedical Instrumentation and Measurements by Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, 2nd Edition, Pearson / PHI Learning,2015
3. BioMedical Instrumentation and Measurements by R. Anandanatarajan,PHI Learning Pvt. Ltd. 2011
4. Bio medical instrumentation – e-TextbookImage
5. Processing by Jerry Prince & Jonathan Links
6. Online datasets: NIH, Kaggle Medical Imaging datasets

26PCSE262 Advanced Algorithms (42-0-0-48) 3

Contact Hours: 90

Course Learning Objectives (CLOs):

This course focuses on asymptotic performance of algorithms, familiarity with major algorithms and data Structures, apply important algorithmic design paradigms and design efficient algorithms in common engineering design situations.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Analyze** time complexities of algorithms using asymptotic analysis and amortized analysis.	-	3	-
CO-2	**Establish** and solve recurrences using tree method, master method, and substitution method.	-	3	-
CO-3	**Design** and implement solutions to engineering problems using Graph algorithms.	3	2	4,6
CO-4	**Explain** and analyze number-theoretic algorithms.	-	2,3	4,6
CO-5	**Implement** and analyze string matching algorithms.	3	2	4,6
CO-6	**Explain** algorithms for solving geometric problems	-	3	6
CO-7	**Explain** and analyze randomized algorithms Multithreaded algorithms	-	3	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**-**	**2.0**	**2.3**	**1.0**	**-**	**1.0**

Pre requisites: Knowledge of Data Structures

Contents:

1. **Review of Analysis Techniques:** Recurrences and Solution of Recurrence equations- The substitution method, The recurrence – tree method, The master method; Amortized Analysis: Aggregate, Accounting and Potential Methods. NP-Completeness and Approximation Algorithms: Complexity classes: P, NP, NP-complete, Cook's Theorem and Randomized algorithms. **08Hrs**
2. **Graph Algorithms:** Single source shortest paths in a DAG; Johnson's Algorithm for sparse graphs; Flow networks and Ford-Fulkerson method; Maximum bipartite Matching. **05Hrs**
3. **Number-Theoretic Algorithms**: GCD, Modular Arithmetic, Solving modular linear equations, The Chinese remainder theorem. **Multithreaded Algorithms**: The basics of dynamic multithreading, Multithreaded matrix multiplication **13Hrs**
4. **String-Matching Algorithms:** Suffix trees and arrays Sequence alignment: Needleman-Wunsch and Smith-Waterman. Applications: DNA sequencing, genomic analysis **06Hrs**
5. **Probabilistic Analysis and Randomized Algorithms**: The hiring problem, Indicator random variables, Randomized algorithm. Streaming algorithms, Online algorithms, Quantum computing basics (quantum algorithms overview). Approximate and probabilistic data structures: Bloom filters, Count-min sketch.
   . **10Hrs**

Reference Books:

1. T. H Cormen, C E Leiserson, R L Rivest and C Stein "Introduction to Algorithms", 3rd Edition, Prentice -Hall of India, 2010.
2. Kenneth A. Berman, Jerome L. Paul "Algorithms", Cengage Learning, 2002
3. Ellis Horowitz, SartajSahni, S.Rajasekharan "Fundamentals of computer Algorithms", 2nd Edition, Universities press, 2007
4. Vijay V. Vazirani "Approximation Algorithms" Edition: 1st Edition Publication Year: 2001 (Springer edition often cited; reprints later) Publisher: Springer (Berlin / New York) ISBN: 978-3540653677
5. Michael Mitzenmacher & Eli Upfal "Probability and Computing: Randomized Algorithms and Probabilistic Analysis" Edition: 1st Edition (2005), updated edition (2017) Publication Year: 2005 Publisher: Cambridge University Press ISBN: 978-0521835404
6. Jon Kleinberg & Éva Tardos "Algorithm Design" Edition: 1st Edition (widely

used), later updates available Publication Year: 2005 (original), later Pearson editions up to 2011/2021 Publisher: Pearson / Addison-Wesley ISBN: 978-0321295354

7. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani “Algorithms” Edition: 1st Edition Publication Year: 2006 Publisher: McGraw-Hill Higher Education ISBN: 978-0073523408

26PCSE263 Human Computer Interface (42-0-0-48) 3

Contact Hours: 90

Course Learning Objectives (CLOs):

This course aims to provide students with a comprehensive understanding of Human-Computer Interaction principles, theories, and methodologies. The students will be able to analyze and evaluate interactive systems from various user perspectives and enhance the user experience

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course, the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Explain** the principles of Human Computer Interaction	-	2,3	-
CO-2	**Design** interactive systems using relevant frameworks	3	4,2	-
CO-3	**Demonstrate** the understanding of HCI design principles and apply user-centered design processes, tools & techniques to create intuitive user-friendly interfaces	3,4	2	-
CO-4	**Design** user interface management systems through expert analysis and user participation by integrating universal design principles to ensure inclusive user support	3,2	4	-
CO-5	**Develop** HCI using appropriate architectural structures	3,2	4	-

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**-**	**2.4**	**2.8**	**1.8**	**-**	**-**

Pre requisites: Knowledge of user interface design

Contents:

1. **HCI - Foundations:** Introduction, Input–output channels, Human memory, thinking: reasoning and problem solving, Emotion, Individual differences, Psychology and the design of interactive systems, Text entry devices, Positioning, pointing and drawing, Display devices, Devices for virtual reality and 3D interaction, Physical controls, sensors and special devices, Paper: printing and scanning. **08Hrs**
2. **Designing - Programming Interactive systems:** Models of interaction, Frameworks and HCI, Ergonomics, Interaction styles, Elements of the WIMP interface, The context of the interaction, Experience, engagement and fun, Paradigms for interaction. **08Hrs**
3. **Centered design and testing:** Interaction design basics-The process of design, User focus, Scenarios, Navigation design, Screen design and layout, Iteration and prototyping, Design for non-Mouse interfaces, HCI in the software process, Iterative design and prototyping, Design rules, Principles to support usability, Standards and Guidelines, Golden rules and heuristics, HCI patterns. **10Hrs**
4. **Implementation support:** Elements of windowing systems, Programming the application, Using toolkits, User interface management systems, Evaluation techniques, Evaluation through expert analysis, Evaluation through user participation, Universal design, User support. **08Hrs**
5. **Models and Theories:** Cognitive models, Goal and task hierarchies, Linguistic models, The challenge of display-based systems, Physical and device models, Cognitive architectures.
   Collaboration & communication: Face-to-face communication, Conversation, Text-based communication, Group working, Dialog design notations, Diagrammatic notations, Textual dialog notations, Dialog semantics, Dialog analysis and design. **08Hrs**

Reference Books:

1. A Dix, Janet Finlay, G D Abowd, R Beale, “Human-Computer Interaction”, 3rd Edition, Pearson Publishers, 2008.
2. Shneiderman, Plaisant, Cohen and Jacobs, “Designing the User Interface: Strategies for Effective Human Computer Interaction”, 5th Edition, Pearson Publishers, 2010.
3. Jonathan Lazar et al "Research Methods in Human Computer Interaction", 2nd Edition, Morgan Kaufmann Publication 2017

26PCSP208 Minor Project / Pedagogical Skill Development (0-0-28) 2

Contact Hours:28

Course Learning Objectives (CLOs): This course enables the student to identify the community expectations in terms of possible engineering solutions, Literature survey and identify the gap, prepare project proposal.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 6)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** and **analyze** the societal problems in real environment **and formulate** the problem statement.	3,4	1,2	5,6
CO-2	**Conduct** exhaustive literature survey.	3,4	1,2	5,6
CO-3	**Design** sustainable engineering solutions / prototypes.	3,4	1,2	5,6
CO-4	**Prepare** the report and communicate effectively through presentation.	3,4	1,2	5,6
CO-5	**Evaluate** and optimize project resources for effective execution in disciplinary or multidisciplinary domains.	3,4	1,2	5,6

Mapping Level:

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**
Mapping Level	**2**	**2**	**3**	**3**	**1**	**1**

Guidelines for conduction:

1. Each student should identify the problem definition by doing proper literature survey.
2. In consultation with guide, the student should carry out their project work.
3. Final evaluation is based on the following evidence will be looked into and

accordingly rubrics will be developed, such as problem statement, design, prototype/part of implementation, use of standard tools and techniques for testing and validation procedure.

4. This requires a designated committee to monitor the process of conduction.